IN THE CLAIMS:

Please amend the claims to the form indicated below.

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13. (Once amended) A method of making a semiconductor device, comprising the steps of:

forming a product in a PECVD chamber through an interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma; and

exposing a substrate to said product.

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15. (Once amended) The method in claim 14, wherein said step of exposing a substrate to said product further comprises forming a metal layer free of constituents of said chemically inert charged species producer gas.

Marked versions of these claims appear in an appendix to this Amendment and Response.

REMARKS

Claims 13-18, 22-26, and 28 are pending.
Claims 13-18, 22-26, and 28 are rejected.
Claims 13 and 15 are amended.
Applicants request reconsideration of 13-18, 22-26, and 28.

I. Indication of priority

Per the Examiner's comments, Applicants have amended paragraph **[0000]** (added in the Preliminary Amendment) by inserting the parent's patent number.

II. Rejection of claim under §112

The Examiner rejected claims 13 and 15 as being indefinite based on the term "sufficient." Applicants have clarified claims 13 and 15 by removing the term "sufficient."

III. Rejection of claims under §102

The Examiner rejected claims 13-18, 22-26, and 28 as being anticipated by U.S. Pat. No. 6,051,286 by Zhao et al. In attempting to support the rejection, the Examiner cited various portions of Zhao. Applicants contend, however, that the text of those citations do not support the Examiner's interpretation, thereby indicating that the Examiner has failed to meet the burden for rejecting these claims.

For example, in attempting to support the rejection of claim 13, the Examiner announced that Zhao et al. teaches interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma. (Office Action dated 3/7/2 at p. 3.) For support, the Examiner cited Zhao's fig. 17 references 952 and 956; Abstract; figure 19 references 1014 and 1015; figure 21; col. 2, ln. 17-18; col. 5, ln. 30-35; col. 6, ln. 44-46; and claims 1, 2, and 22. (Office Action dated 3/7/2 at p. 3.) A careful analysis of these excerpts, however, indicates that they fail to disclose an interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

For instance, concerning the Examiner's citation to elements 952 and 956 of Zhao's fig. 17, Applicants note that those elements do not appear in fig. 17. Figure 17 merely illustrates a cross-sectional view of a device. Elements 952 and 956, found in figure 18's cross-section, merely represent a substrate and a titanium contact liner, respectively, of another device. None of these references address interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

Zhao's Abstract also fails to go into such detail:

> [t]he present invention provides systems, methods and apparatus for depositing titanium films at rates up to 200 Å/minute on semiconductor substrates from a titanium tetrachloride source. In accordance with an embodiment of the invention, a ceramic heater

> assembly with an integrated RF plane for bottom powered RF capability allows PECVD deposition at a temperature of at least 400° C. for more efficient plasma treatment. A thermal choke isolates the heater from its support shaft, reducing the thermal gradient across the heater to reduce the risk of breakage and improving temperature uniformity of the heater. A deposition system incorporates a flow restrictor ring and other features that allow a 15 liters/minute flow rate through the chamber with minimal backside deposition and minimized deposition on the bottom of the chamber, thereby reducing the frequency of chamber cleanings, and reducing clean time and seasoning. Deposition and clean processes are also further embodiments of the present invention.

Zhao's figure 19 is a flow chart of a process sequence. That figure's steps 1014 and 1015 specified by the Examiner merely disclose raising the substrate to a deposition height, turning on plasma, and depositing film. The text addressing those steps does not provide any additional guidance concerning interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma. (*See* Zhao at col. 37, ln. 37-56.) Indeed, that text expresses using argon to "establish a stable plasma without needing additional means to ignite a glow discharge," thereby indicating that no such interaction is present or even needed. Having disclosed the opposite of the Examiner's interpretation, this excerpt cannot be interpreted as supporting the Examiner's interpretation.

As for the Examiner's citation to Zhao's figure 21, that graph merely illustrates the relationship between deposition rate and the ratio of $TiCl_4$ vapor pressure to the total pressure ($TiCl_4$ +He) over the liquid source of $TiCl_4$. (Zhao at col. col. 39, ln. 42-48.) This graph does not address interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

Regarding the Examiner's citation to Zhao's col. 2, ln. 17-18, that excerpt is merely a portion of a sentence that refers to target atoms condensing into a thin film on the substrate, which is on the substrate holder. Again, there is no mention of interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

Concerning the Examiner's citation to Zhao's col. 5, ln. 30-35, that excerpt is only a truncated sentence introducing the summary of Zhao's invention and fails to address interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma:

> SUMMARY OF THE INVENTION
> The present invention provides systems, methods, and apparatus for high temperature (at least about 400° C.) processing of substrates in a plasma-enhanced chemical vapor deposition (PECVD) chamber. Embodiments of the present invention include a PECVD system for depositing a . . . .

The Examiner's citation to col. 6, ln. 44-46 merely indicates that the reactant gas/ source gas flow ratio can be almost 250:1. Such disclosure is not relevant to interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

As for the Examiner's citation to claim 1, that claim is silent concerning the interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma:

> 1. A process for depositing a layer on a substrate on a heater in a chamber, said process comprising the steps of:
>
> heating said heater; A [sic]
> pressurizing said chamber;
> introducing a reactant gas and a source gas into said chamber, said source gas comprising a metal and a halogen
> applying RF energy to form a plasma adjacent to the substrate; and
> ramping the flow of said reactant gas, said source gas, and a plasma gas, to avoid thermally shocking said heater.

As for the Examiner's reliance on Zhao's claim 2, that claim specifies a reactant-sources gas flow ratio that may be almost 100:1 as part of introducing the gases. Similar to the excerpt from col. 6, ln. 44-46 discussed above, such disclosure is not relevant to interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma.

The Examiner's citation to Zhao's claim 22 is similarly irrelevant in terms of supporting the Examiner's assumption about interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma. Specifically, claim 22 teaches a reactant gas flow rate that is about 20 to 50 times greater than the flow rate of the source gas.

Thus, none of the Examiner's citations support the Examiner contention that Zhao discloses interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma. As a result, the Examiner has failed to meet the burden for rejecting claim 13. Moreover, the Examiner's contention forms part of the basis for rejecting dependent claims 14-18 as well. Accordingly, the Examiner has failed to meet the burden for rejecting those claims as well.

Similarly, in attempting to support the rejection of independent claims 22, 24, and 28, the Examiner announced that Zhao et al. teaches interacting a metal source gas and inert gas. (Office Action dated 3/7/2 at p. 4.) Significantly, the Examiner once again cited for support Zhao's Abstract; figure 19 references 1014 and 1015; figure 21; col. 2, ln. 17-18; col. 5, ln. 30-35; col. 6, ln. 44-46; and claims 1, 2, and 22. Accordingly, Applicants contend that the analysis presented above supports a similar conclusion -- none of the Examiner's citations support the Examiner's contention that Zhao discloses interacting a metal source gas and inert gas. In fact, there is at least one of the Examiner's excerpt in Zhao which disclose only the opposite. (*See* Zhao at col. 37, ln. 37-56 (disclosing establishing a stable plasma with argon and "without needing additional means to ignite a glow discharge," thereby indicating that no such interaction is present or even needed).) As a result, the Examiner has failed to meet the burden for rejecting independent claims 22, 24, 28 and the relevant dependent claims as well.

Applicants also note that independent claim 13 includes a limitation requiring interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma; independent claim 22 includes an act of interacting a metal source gas and a chemically inert-excitation gas; and independent claim 28 includes a limitation requiring interacting a metal source material with a chemically inert collider gas. Hence, the same analysis demonstrating the Examiner's errors in reasoning also demonstrate that the burden for rejection cannot be met relying on Zhao given that its disclosure is either silent or directly contrary to at least one limitation present in these claims and their dependents.

IV. Rejection based on double patenting

The Examiner rejected claims 13-18, 22-26, and 28 under obviousness-type double patenting in light of U.S. Pat. No. 5,946,594. Applicants are concurrently submitting a terminal disclaimer relevant to that patent.

CONCLUSION

In light of the above amendments and remarks, Applicants submit that claims 13-18, 22-26, and 28 are allowable over the applied reference. Therefore, Applicants respectfully request reconsideration of the Examiner's objections and rejections and further requests allowance of all of the pending claims. If there are any matters which may be resolved or clarified through a telephone interview, the Examiner is requested to contact Applicants' undersigned attorney at the number indicated.

Respectfully submitted,

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Date: 6/5/2

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Appendix 1: Marked version of amended Specification paragraphs

[0000] This application is a divisional of application serial number 09/249,478, filed Feb.[ruary] 12, 1999 <u>and issued as U.S. Pat. No. 6,291,341</u>.

Appendix 2: Marked version of amended claims.

13. (Once amended) A method of making a semiconductor device, comprising the steps of:

forming a product in a PECVD chamber through an interaction of a chemically inert charged species producer gas and a metal-containing compound in a plasma; and

exposing a substrate to said product[for a period sufficient to form a metal layer on at least a portion of said substrate].

15. (Once amended) The method in claim 14, wherein said step of exposing a substrate to said product further comprises [exposing a substrate to said product for a period sufficient to]forming a metal layer free of constituents of said chemically inert charged species producer gas.